UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Electrification and the Grid of the Future	)	Docket No. AD21-12-000

PREPARED REMARKS OF JEFF DENNIS, MANAGING DIRECTOR AND GENERAL COUNSEL, ADVANCED ENERGY ECONOMY

Advanced Energy Economy (AEE) appreciates the opportunity to participate in this important discussion of the accelerating trend of electrification of the nation's economy. We applaud the Commission for initiating an examination of how the Commission and stakeholders should prepare for electrification, and the opportunities and challenges that electrifying transportation, residential and commercial buildings, and other sectors will present for the electric grid.

State, local, and emerging federal policies are requiring steep reductions in greenhouse gas emissions across all sectors of the economy. Achieving these reductions requires an electricity system made up of predominantly zero-carbon advanced energy generation technologies, serving increasingly electrified transportation and residential and commercial buildings. Ensuring that the bulk electric system is adequate to satisfy the demands of decarbonization and electrification, and that wholesale markets cost-effectively integrate all of the advanced energy technologies that will be deployed, should be a focus for the Commission in the years ahead.

I. About Advanced Energy Economy

AEE is a national association of businesses that are making the energy we use secure, clean, and affordable. AEE is the only industry association in the United States that represents the full range of advanced energy technologies and services, both grid-scale and distributed. Advanced

energy includes energy efficiency, demand response, energy storage, wind, solar, hydro, nuclear, electric vehicles, and more. AEE also supports the work of the Advanced Energy Buyers Group ("AEBG"), a coalition of large buyers of advanced energy technologies who use them to meet sustainability and clean energy goals.[1]

II. Electrification is accelerating in response to a combination of low and zero carbon policy directives, cost declines and performance improvements in advanced technologies for generating and utilizing clean electricity as a fuel source, and consumer preferences for those technologies.

The key drivers of electrification in the United States are federal, state, and local policies requiring decarbonization of various sectors of the economy; technology advancements and cost declines in advanced energy technologies that produce and utilize clean electricity as their primary fuel source; and individual consumer preferences.

Several major policies focused on decarbonization of the economy have been enacted by state and local governments in the past several years, and to date, those policies have been a primary driver of electrification trends overall. According to the Environmental Protection Agency ("EPA"), the top sectors contributing to total U.S. greenhouse gas emissions in 2019 were transportation (29%), electricity (25%), industry (23%), and commercial and residential (13%).[2] Recognizing these leading contributors to overall carbon emissions, these policies have focused on decarbonization of electricity supply first, followed by the transportation and residential and commercial building sectors.

[1] These remarks represent the views of AEE staff, and do not necessarily represent the views of any AEE or AEBG member.

[2] EPA, "Sources of Greenhouse Gas Emissions", *available at* https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.

As the Commission knows well, 18 states plus the District of Columbia and Puerto Rico have 100 percent clean electricity standards or goals, with many of those enacted in statute.[3] These policies lay the foundation for clean electricity to be a core pillar of state efforts to broadly address greenhouse gas emissions across the economy. From among these jurisdictions, 12 states plus the District of Columbia have economy-wide decarbonization targets or goals, and beyond those there are additional states with economy-wide decarbonization targets that have not adopted 100 percent clean electricity targets. The New England states, for example, have all set limits or goals to reduce greenhouse gas emissions by 80 percent or more by 2050.[4] New York's 2019 Climate Leadership and Community Protection Act calls for a 40 percent reduction in economy-wide greenhouse gas emissions by 2030, and an 85 percent reduction by 2050.[5] California law accelerates the growth of advanced energy and renewable resources by requiring the state's electricity providers to achieve a 100% clean and zero carbon goal by 2045[6], and an Executive Order establishes a goal for the state to become carbon neutral, economy-wide, by 2045.[7]

Local governments have also adopted a range of policies aimed at achieving decarbonization of their communities that include a prominent role for electrification. Over 204 cities and counties in 37 states have 100% clean energy commitments or achievements, and cities overall are driving significant deployment of carbon-free renewable energy.[8] In addition,

[3] *See, e.g.*, Advanced Energy Economy, Map: States with 100% Clean or Renewable Energy Goals (March 2021), available at https://info.aee.net/map-states-with-100-clean-or-renewable-energy-goals.
[4] *See* The Brattle Group, "Achieving 80% GHG Reduction in New England by 2050" at 8 (September 2019), *available at* https://brattlefiles.blob.core.windows.net/files/17233_achieving_80_percent_ghg_reduction_in_new_england_by_20150_september_2019.pdf.
[5] New York State, Senate Bill 6599 (2019-2020 Session), *available at* https://www.nysenate.gov/legislation/bills/2019/s6599.
[6] California, Senate Bill 100 (2017-2018 Session), *available at* https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100.
[7] California Governor, Executive Order B-55-18 to Achieve Carbon Neutrality (September 10, 2018), *available at* https://www.californiabiodiversityinitiative.org/pdf/executive-order-b-55-18.pdf.
[8] *See, e.g.*, UCLA Luskin Center for Innovation, "Progress Toward 100% Clean Energy in Cities & States Across the U.S." (November 2019), *available at* https://innovation.luskin.ucla.edu/wp-content/uploads/

municipalities across the country, from Houston, Texas, to Los Angeles, California, have made commitments to electrify their municipal fleets, which range from light-duty passenger vehicles to medium- and heavy-duty trucks and buses.[9,10] Municipal governments are also implementing policies to support the transition to fully electric buildings. In 2019, Berkeley, California, became the first city in the United States to prohibit natural gas in all new building construction.[11]

Federal policies to address climate change and reduce greenhouse gas emissions are now beginning to join these state and local policy efforts, and can be expected to drive electrification of the economy even further. The President's January 27, 2021, Executive Order on "Tackling the Climate Crisis at Home and Abroad," for example, directs the federal government to procure clean electricity to power its own operations, and to purchase all clean and zero-emissions vehicles for use in its fleets, a move that will drive significant demand for electric vehicles.[12] In addition, the United States rejoined the Paris Agreement,[13] and on April 22, 2021, the President announced a target of reducing U.S. greenhouse gas emissions by 50-52 percent from 2005 levels by 2030.[14]

2019/11/100-Clean-Energy-Progress-Report-UCLA-2.pdf; Goncalves, T., Liu, T., World Resources Institute, "How US Cities and Counties Are Getting Renewable Energy" (June 2020), *available at* https://www.wri.org/insights/how-us-cities-and-counties-are-getting-renewable-energy.

[9] Environment Texas, TexPIRG, Frontier Group, "An Electric Vehicle Toolkit for Local Governments and Texas Communities" (March 2021), *available at* https://environmenttexas.org/sites/environment/files/reports/FRG%20Texas%20EV%20Toolkit%20Feb21%201.4.pdf.

[10] City of Los Angeles, "Mayor Garcetti Announces that City of Los Angeles is Now Home to Largest Electric Vehicle Fleet in the U.S." (March 2016), *available at* https://www.lamayor.org/mayor-garcetti-announces-city-los-angeles-now-home-largest-electric-vehicle-fleet-us.

[11] Southwest Energy Efficiency Project, "Building Electrification: How Cities and Counties are Implementing Electrification Policies" (2020), *available at* https://swenergy.org/pubs/building_electrification

[12] "Executive Order on Tackling the Climate Crisis at Home and Abroad", Section 205, *available at* https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.

[13] U.S. Department of State, "The United States Officially Rejoins the Paris Agreement" (January 2021), *available at* https://www.state.gov/the-united-states-officially-rejoins-the-paris-agreement/#:~:text=On%20January%2020%2C%20on%20his,becomes%20a%20Party%20again%20today.

[14] The White House, "FACT SHEET: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies" (April 2021), *available at* https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/.

To achieve the steep greenhouse gas emissions reductions these state, local, and emerging federal policies call for, experts agree that significant electrification of transportation and commercial and residential buildings, along with acceleration of energy efficiency measures and retooling of the industrial sector, will be essential.[15] These policies, along with recent technology advancements and cost declines in electrified transportation and in commercial and residential building technologies utilizing electricity as the primary fuel source, are thus driving significant growth in market revenues for the advanced transportation and building efficiency segments of the advanced energy industry. AEE's 2021 Market Report shows that advanced transportation revenue in the U.S. grew to $37.7 billion in 2020, a 16 percent increase from 2019, with plug-in electric vehicle sales revenue alone growing 19 percent.[16] The building efficiency market segment, which includes products and services that support building electrification and energy conservation, such as high efficiency HVAC systems (including air-source heat pumps) and associated controls, grew to $94.5 billion in revenue in 2020.[17] As decarbonization policies and goals move forward, Guidehouse Insights estimates that U.S. spending on commercial heat pumps will grow at a rate of 13 percent between 2020 and 2029.[18]

III. The transportation and buildings sectors are the primary focus of electrification policy and consumer demand, and advanced energy technologies in these sectors are maturing rapidly to satisfy rising expectations.

[15] *See, e.g.,* Princeton University, "Net-Zero America: Potential Pathways, Infrastructure, and Impacts" (Dec. 15, 2020), *available at* https://netzeroamerica.princeton.edu/img/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf; The Brattle Group, "New York's Evolution to a Zero Emission Power System" at 8 (May 2020), *available at* https://www.nyiso.com/documents/20142/12610513/Brattle%20New%20York%20Electric%20Grid%20Evolution%20Study.pdf; *see also* Energy Innovation, "Technologies And Policies To Decarbonize Global Industry: Review And Assessment Of Mitigation Drivers Through 2070" (April 2020), *available at* https://energyinnovation.org/publication/technologies-and-policies-to-decarbonize-global-industry-review-and-assessment-of-mitigation-drivers-through-2070/.

[16] Advanced Energy Economy, "Advanced Energy Now: 2021 Market Report" at 29 (April 2020), *available at* https://info.aee.net/aen-2021-market-report ("AEE 2021 Market Report").

[17] *Id*. at 11.

[18] *Id.* at 17.

As noted above, electrification of transportation and of the commercial and residential building sectors are two central pillars of achieving decarbonization goals. While technology improvements, cost declines, and consumer preferences are already making these two sectors the leaders in electrification, state, local, and emerging federal policies are focused on encouraging an even larger shift to electrified technologies in these sectors.

With respect to the transportation sector, fuel economy and vehicle emissions standards are key policy drivers for electrification of vehicles, especially light duty passenger vehicles. Last year, California announced that it would require 100 percent of new cars, light trucks, and to the extent possible, off-road vehicles sold in the state to be zero emission by 2035.[19] Recently, governors from a dozen states, including New York, New Jersey, North Carolina and Washington, signed a letter urging President Biden to set federal standards to ensure that all new passenger cars and light-duty trucks sold are zero-emission no later than 2035 and all medium- and heavy-duty vehicles are on a path to be fully zero-emission by 2045.[20] At the federal level, as noted above, the President's January 27, 2021, Executive Order requires the federal government to purchase clean and zero-emission vehicles for its own use. Transitioning the federal fleet alone will ultimately result in over 600,000 new electric vehicles on the road;[21] the efforts of California and additional states like New Jersey and Virginia to move to 100 percent clean car sales in the next 15 years will add exponentially more vehicles to this figure. The President has also directed the Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration

[19] *See* Advanced Energy Economy, "So California's Going 100% Electric by 2035 – Just What EVs Need to Take Off" (Oct. 8, 2020), *available at* https://blog.aee.net/so-californias-going-100-electric-by-2035-just-what-evs-need-to-take-off.
[20] Letter *available at* https://www.gov.ca.gov/wp-content/uploads/2021/04/4.21.21-Multi-State-Governors-ZEV-Letter.pdf.
[21] World Resources Institute, "4 Recommendations to Electrify the US Federal Fleet" (February 2021), *available at* https://www.wri.org/insights/4-recommendations-electrify-us-federal-fleet.

(NHTSA) to review and, consistent with applicable law, revise and strengthen the national greenhouse gas and fuel economy standards for vehicles established during the last Administration.[22] Higher average fuel economy standards applied to automaker fleets provides a strong incentive for them to produce more zero-emission vehicles, which have a very high miles-per-gallon equivalent.[23]

Electrification of residential and commercial buildings is also increasingly a focus of state and local policies. These jurisdictions are concluding that significant building decarbonization will be necessary to meet their overall greenhouse gas reduction goals.[24] In particular, state and city building codes and performance standards are driving electrification of home heating systems and appliances.[25] Codes and standards requiring that new buildings rely on electricity rather than fossil fuels for end uses, providing incentives for existing buildings to phase out fossil fuel-powered heating systems, and placing moratoriums or restrictions on the expansion of local natural gas distribution systems and connections, are some of the common ways in which states and local governments are addressing building electrification.

Advanced energy technologies in each of these sectors are maturing, and their costs are dropping, accelerating their market growth beyond what governments are requiring. In the transportation sector, rapidly improving battery technology means both lower upfront prices—analysts estimate that the upfront cost of an electric vehicle will be equivalent to its ICE counterpart

[22] "Executive Order on Protecting Public Health and Environment and Restoring Science to Tackle the Climate Crisis," Section 2, *available at* https://www.whitehouse.gov/briefing-room/presidentialactions/2021/01/20/executive-order-protecting-public-health-and-environment-and-restoring-science-to-tackle-climate-crisis/

[23] *See* World Energy Council, "E-mobility: Closing the Emissions Gap" (2016), *available at* https://www.worldenergy.org/assets/downloads/E-Mobility-Closing-the-emissions-gap_full-report_FINAL_2016.06.20.pdf.

[24] *See, e.g.,* New Jersey Board of Public Utilities, et al., "2019 Energy Master Plan: Pathway to 2050", *available at* https://www.nj.gov/emp/docs/pdf/2020_NJBPU_EMP.pdf.

[25] Rocky Mountain Institute, "2020: Watt a Year for Building Electrification!" (December 16, 2020), *available at* https://rmi.org/2020-watt-a-year-for-building-electrification/.

as soon as 2022[26]—and the introduction of additional makes and models with driving ranges exceeding 200-300 miles per charge.[27]

With respect to buildings, electric heat pumps (in particular, variable refrigerant flow (VRF) systems) are the primary technology being deployed around the world and, increasingly, in the United States.[28] These technologies are widely viewed as the key to building electrification, and have already seen sustained growth in adoption over the past five years.[29] The U.S. is now a major growth market for heat pumps and VRF manufacturers, especially in regions with moderate temperatures like California, where economic and policy factors are driving adoption of the technology.[30] While some heat pumps have technical limitations in colder regions of the U.S., cold weather models are increasingly available.

IV. Electrification is generally expected to change the patterns of electricity demand and result in increased demand growth over the long-term.

Most available studies show that electrification will result in significant increases in electricity demand and the generation capacity needed to meet that demand. The Brattle Group has conducted studies of the expected increases in low and zero-carbon generation capacity needed to meet greenhouse gas reduction goals, and the accompanying electrification of transportation and other sectors that will be needed to satisfy those goals. These studies are generally representative of what we can expect across the U.S., although the pace of electrification and amount of energy required for building heating and other uses may vary by region.

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[26] Deloitte, "New Markets. New Entrants. New Challenges: Battery Electric Vehicles" (2019), *available at* https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/manufacturing/deloitte-uk-battery-electric-vehicles.pdf.
[27] MarketWatch, "The 10 electric cars with the longest range" (May 19, 2020), *available at* https://www.marketwatch.com/story/the-10-electric-cars-with-the-longest-range-2020-05-19
[28] AEE 2021 Market Report at 17.
[29] *Id.* at 11 (showing steep increase in U.S. HVAC revenues between 2011 and 2020).
[30] *Id.* at 17.

In New England, Brattle found that electrification associated with achieving the region's decarbonization goals is likely to double electricity demand by 2050 (relative to 2018).[31] Notably, the extent to which energy efficiency is deployed plays a key role in how much demand grows; the "efficiency focused" scenario studied by Brattle showed a 77% increase in demand, while other scenarios reached as much as a 136% increase.[32] In New York, Brattle concluded that a high electrification scenario would result in the need for 43 gigawatts of additional capacity by 2040, with 75 terawatt-hours more annua generation.[33]

The Midcontinent Independent System Operator (MISO) has also examined several forward-looking planning scenarios that consider different ranges of economic, policy, and technological possibilities, including the impact of various potential levels of electrification. An analysis prepared for MISO concluded that new loads from electrification of commercial, residential, and industrial uses as well as light-duty vehicles could result in compound annual growth rates in demand of anywhere from 1% (in a 10% load growth scenario) to 3.2% (in a 70% load growth scenario).[34]

These likely demand increases are also expected to come with new patterns of demand. The electrification of residential and commercial building heating systems is likely to create new winter peaking requirements, even on systems that have historically planned primarily to meet summer peaking needs.[35] In addition, electrification of transportation could increase daily hourly

[31] The Brattle Group, "Achieving 80% GHG Reduction in New England by 2050" at 8 (September 2019), *available at* https://brattlefiles.blob.core.windows.net/files/17233_achieving_80_percent_ghg_reduction_in_new_england_by_20150_september_2019.pdf
[32] *Id.*
[33] The Brattle Group, "New York's Evolution to a Zero Emission Power System" at 36-37.
[34] Applied Energy Group, "MISO Electrification Load-Growth Assessment: Residential, Commercial, Industrial, and Light-Duty Vehicles" at 13 (September 2019), *available at* https://cdn.misoenergy.org/20200427%20MTEP%20Futures%20Item%2002a%20AEG%20Electrification%20Results%20444194.pdf.
[35] *See, e.g.*, The Brattle Group, "New York's Evolution to a Zero Emission Power System" at 12.

load variations as vehicles are charged at different times.[36] The extent to which these demand patterns are realized will depend greatly on how regulators and grid operators respond. For example, as noted above, deploying energy efficiency can reduce the magnitude of these new peaks and load variations. In addition, distributed energy storage, smart connect devices and homes, and electric vehicles and their associated supply equipment can be utilized as flexible grid resources to reduce the magnitude of peak events or actively manage variations in load.

Finally, it is important to highlight that electrification of transportation, buildings, and other sectors will drive significant deployment of renewable energy generation, and a corresponding need for increased development of transmission to deliver that generation. This is the first finding in the National Renewable Energy Laboratory's Electrification Future Study; it notes that growth in renewables to meet clean electrification demands in a high electrification scenario comes with a large corresponding expansion of long-distance transmission capacity.[37]

V. Electrification can deliver benefits to marginalized and underserved communities, provided that government policy sets appropriate direction.

Shifting away from combustion of fossil fuels and toward the use of zero-emission technologies like electric vehicles and electric building heating technologies can provide significant benefits to marginalized communities, especially frontline communities near highways, transit centers, and freight and fleet hubs where vehicle emissions can be concentrated.[38] Electrifying school bus fleets to power them with clean electricity, for example, holds promise for

[36] *Id.*
[37] National Renewable Energy Laboratory, "Electrification Futures Study: Scenarios of Power System Evolution" at 14 (January 2021), *available at* https://www.nrel.gov/docs/fy21osti/78783.pdf.
[38] University of California Berkeley, "The 2035 Report: Transportation", Summary, *available at* https://www.2035report.com/transportation/ ("Combined with a 90 percent clean energy grid, electrifying all new cars and trucks by 2035 would prevent 150,000 premature deaths and avoid $1.3 trillion in environmental and health costs through 2050 by reducing air pollution, especially in frontline communities near major roads, transit centers, or freight hubs.")

improving the health of school children and keeping more money for the classroom due to lower maintenance and fueling costs.[39]

State policies, and emerging federal priorities, are seeking to ensure that the economic benefits of decarbonization and electrification of economic sectors like transportation are shared by historically disadvantaged communities. New York's 2019 Climate Leadership and Community Protection Act provides an example; it directs state agencies, in consultation with an environmental justice working group established by the Act, to direct investments in a manner that ensures that disadvantaged communities receive 40 percent of the overall benefits of spending on decarbonization efforts.[40] Similarly, President Biden's Executive Order on "Tackling the Climate Crisis at Home and Abroad" establishes a goal that 40 percent of federal clean energy and climate investments flow to disadvantaged communities.[41]

VI. The Commission should consider how these existing and growing trends in electrification will impact the bulk electric system and the wholesale electricity markets it regulates, and how its policies may need to evolve.

As explained above, electrification of sectors like transportation and residential and commercial buildings are key pillars of state, local, and emerging federal policy strategies and customer goals to reduce greenhouse gas emissions. That makes a clean electricity system the foundation of decarbonization goals, and puts the bulk electric transmission system and wholesale

[39] Environment and Energy Study Institute, "Electrifying Virginia's School Bus Fleet" (Sept. 28, 2020), *available at* https://www.eesi.org/articles/view/electrifying-virginias-school-bus-fleet (summarizing the findings of Dominion Energy on the benefits of its school bus electrification program; Dominion Energy found, among other things, that "with no air pollutants released, the air quality inside each electric school bus is six times better than the diesel alternative").

[40] New York State, Senate Bill 6599 (2019-2020 Session), *available at* https://www.nysenate.gov/legislation/bills/2019/s6599.

[41] "Executive Order on Tackling the Climate Crisis at Home and Abroad", Section 223, *available at* https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.

electricity markets regulated by the Commission at the center of efforts to decarbonize the economy.

Electrification of these and other economic sectors, as noted above, is expected to drive increases in demand for electricity, predominantly from new clean advanced energy resources, and significant changes in demand patterns and variability across seasons, days, and hours.[42] These electrification-driven changes in demand and new operational realities for grid operators will have implications for the Commission's statutory mission of ensuring just and reasonable rates and preventing undue discrimination in the sale of wholesale power and provision of transmission service.

For example, the expectation that decarbonization and electrification will result in significant additions of capacity from low- and zero-carbon advanced energy resources over the next 10 to 20 years requires a renewed focus on encouraging the development of larger and more integrated regional and interregional transmission systems and wholesale power markets. Broader regional competitive wholesale markets provide a platform for more optimized transmission planning and non-discriminatory access to transmission service at a single rate over a broader geographic area, allowing for more efficient development and sharing of generating resources across that area to meet reliability needs.[43] The ability to share resources across a broader area, combined with operation as a single balancing authority, also provides increased flexibility and resilience in response to the more dynamic seasonal and daily demand patterns that a decarbonized economy creates, by providing a means to shift available electricity supplies from where they are available to where they are needed. Broader regional wholesale markets have already supported

[42] *See, e.g.*, The Brattle Group, "New York's Evolution to a Zero Emission Power System" at 14.
[43] *See, e.g.*, Advanced Energy Economy, "Principles for the Creation of Broader Regional Wholesale Markets in the West" at 1-2 (October 2019), *available at* https://info.aee.net/hubfs/AEE%20Western%20Wholesale%20Market%20Principles%2010.08.19-2.pdf.

significant decarbonization and development of carbon-free energy, and the Commission should carefully consider how these markets can be leveraged to address the impacts of a decarbonized economy on electricity supply needs and grid operations.[44]

In addition, the increasingly dynamic seasonal, daily, and hourly nature of electricity demands and system peaking events will require increased flexibility in both supply resources and in loads.[45] Wholesale electricity markets will require improvements to ensure that they account for this need for flexibility to ensure reliability and resource adequacy and have mechanisms to value and procure this flexibility from a broad set of technologies, from wind and solar resources with advanced controls[46] to distributed energy resources like energy storage, demand response, and distributed generation.[47]

In addition, electrification of transportation, residential and commercial buildings, and other economic sectors will accelerate the development of a growing set of distributed energy resources that can be optimized through aggregation to provide wholesale market services. The Commission has already recognized in Order No. 2222 the importance to just and reasonable rates of ensuring that organized wholesale electricity markets allow aggregations of distributed energy resources to compete to provide all of the services they are technically capable of providing.[48]

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[44] *See* Advanced Energy Buyers Group, "Organized Wholesale Markets and Advanced Energy Procurement" (Jan. 2021), *available at* https://info.aee.net/hubfs/AEE_AEBG%20-%20WholesaleMkts_1.19.21.pdf (describing decarbonization and clean energy contracting benefits of broader regional wholesale markets).

[45] *See, e.g.*, The Brattle Group, "New York's Evolution to a Zero Emission Power System" at 13.

[46] *See, e.g.,* California Independent System Operator et al., "Avangrid Renewables Tule Wind Farm: Demonstration of Capability to Provide Essential Grid Services" (March 2020), *available at* http://www.caiso.com/Documents/WindPowerPlantTestResults.pdf; California Independent System Operator et al., "Using Renewables to Operate a Low-Carbon Grid: Demonstration of Advanced Reliability Services from a Utility-Scale Solar PV Plant" (2018), *available at* http://www.caiso.com/Documents/UsingRenewablesToOperateLow-CarbonGrid.pdf.

[47] Advanced Energy Economy, "Putting Distributed Energy Resources to Work in Wholesale Markets" (September 2019), *available at* https://info.aee.net/hubfs/Putting%20Distributed%20Energy%20Resources%20to%20Work%20in%20Wholesale%20Electricity%20Markets.pdf.

[48] *Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 2222, 172 FERC ¶ 61,247 (2020)*, order on reh'g*, Order No. 2222-A, 174 FERC ¶ 61,197 (2021).

Provision of wholesale services by electrified vehicle fleets and associated supply equipment, distributed energy resources installed in "grid-interactive" buildings, and other electrified end-use products provides an important revenue opportunity for developers of advanced transportation and building electrification and efficiency solutions that allow them to reduce the cost of their products and services to end users, while also providing benefits to consumers and the grid by maximizing their utilization. As electrification accelerates, the Commission should continue to assess the need to ensure that this growing set of resources is able to provide wholesale services not just in organized wholesale markets, but in all regions of the country, as well as the extent to which these resources can be utilized to support the transmission system and provide "non-wires alternatives" where cost-effective. In addition, with electrification driving overall electricity demand higher, the Commission should pay close attention to the role of energy efficiency and ensure that it is appropriately accounted for and valued in wholesale power markets.[49] The role of energy efficiency in wholesale markets will be even more critical to ensuring just and reasonable rates as demands created by electrification accelerate.

Finally, fully integrating these resources into wholesale markets (through compliance with Order No. 2222 and potentially other mechanisms) is a key step in unlocking flexibility on the demand side of the market, which will be critical to addressing inter-day and inter-hour fluctuations in demand from technologies like electric vehicles and transportation.[50] Integrating these and other distributed energy resources will improve operator visibility of their status and

[49] *See* The Brattle Group, "The Benefits of Energy Efficiency Participation in Capacity Markets" (April 2021), *available at* https://info.aee.net/hubfs/The%20Benefits%20of%20Energy%20Efficiency%20Participation%20in%20Capacity%20Markets1.pdf; The Brattle Group, "Enabling Cost-Effective Energy Efficiency in the Midcontinent ISO Resource Adequacy Construct" (April 2021), *available at* https://info.aee.net/hubfs/Enabling-Cost-Effective-Energy%20Efficiency-in-the-Midcontinent-ISO%20Resource-Adequacy%20Construct_.pdf.

[50] *See, e.g.*, The Brattle Group, "New York's Evolution to a Zero Emission Power System" at 13.

capabilities, and also lay the foundation for further technological advancement to allow loads to be dispatched and managed in response to grid flexibility and reliability needs.

VII. Conclusion

AEE thanks the Commission for the opportunity to share our perspectives on the key drivers of electrification and how trends in electrification of the economy will impact the electric grid of the future. A low- to zero-carbon electricity system with significant additions of zero-carbon advanced energy resources is poised to be the foundation for broader efforts to decarbonize the economy through electrification. The transportation and residential and commercial building sectors are already seeing increased electrification that is expected to accelerate as a result of state, local, and emerging federal decarbonization policies. We look forward to working with the Commission as it assesses the impacts of electrification on the wholesale power markets and transmission grid it regulates and considers new policies and actions to address those impacts and ensure that rates remain just and reasonable.

Respectfully submitted,

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